US009679736B2

(12) **United States Patent**
Lan et al.

(10) **Patent No.: US 9,679,736 B2**
(45) **Date of Patent: Jun. 13, 2017**

(54) **ENCAPSULATED STRUCTURE FOR X-RAY GENERATOR WITH COLD CATHODE AND METHOD OF VACUUMING THE SAME**

(71) Applicant: **Energy Resources International Co., Ltd.**, New Taipei (TW)

(72) Inventors: **Wen-How Lan**, New Taipei (TW); **Yi-Teng Shiu**, New Taipei (TW); **Hung-Chiang Huang**, New Taiepi (TW)

(73) Assignee: **Energy Resources International Co., Ltd.**, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 41 days.

(21) Appl. No.: **14/948,015**

(22) Filed: **Nov. 20, 2015**

(65) **Prior Publication Data**

US 2016/0148777 A1 May 26, 2016

(30) **Foreign Application Priority Data**

Nov. 20, 2014 (TW) ..... 103140325 A

(51) **Int. Cl.**
H01J 35/06 (2006.01)
H01J 9/39 (2006.01)

(52) **U.S. Cl.**
CPC ***H01J 35/065*** (2013.01); ***H01J 9/39*** (2013.01)

(58) **Field of Classification Search**
CPC H01J 35/065; H01J 2235/068; H01J 2235/062; H01J 35/06; H01J 35/08; H01J 35/16; H01J 2201/30469; H01J 1/304
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,353,658	B1 *	3/2002	Trebes	A61N 5/1001 378/119
6,553,096	B1	4/2003	Zhou et al.	
8,559,599	B2	10/2013	Lee et al.	
2005/0031083	A1 *	2/2005	Kindlein	A61N 5/1001 378/136
2011/0255664	A1 *	10/2011	Ueda	H01J 35/065 378/62
2013/0028386	A1 *	1/2013	Jeong	H01J 35/20 378/122

* cited by examiner

Primary Examiner — Hoon Song
(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds & Lowe, P.C.

(57) **ABSTRACT**

An encapsulated structure of an X ray generator with a cold cathode and method of vacuuming the same are disclosed. The X ray generator has a glass ball-tube having a base, a tungsten filament, a cold cathode, a focus cap, and an anode target inside, associated with a first electrode pin, a second electrode pin, a single-used pin, and anode pin extended out. The tungsten filament located at the periphery of the base has a first wire end connected with the second electrode pin and a second wire end connected with the single-used pin. While vacuuming the glass ball-tube before melting an end to seal, a voltage is exerting on the single use pin to heat the tungsten, and a high voltage is exerting on the anode target to accelerate the hot electrons emitting from the filament to bombard the inside wall of the glass ball-tube and the anode target so as to shorten the vacuuming time and increase the vacuum level.

10 Claims, 6 Drawing Sheets